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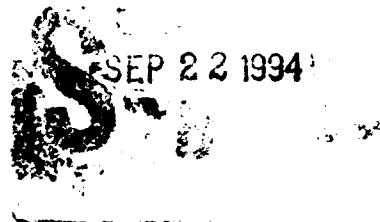


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PAK: A Processing System for Vectorized Time-Series Data

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PAK:

A PROCESSING SYSTEM FOR VECTORIZED TIME-SERIES DATA

INTRODUCTION

PAK evolved from a sequence of analysis systems having their genesis in a system called FESTSA [1]. The original system was designed to run on a UNIVAC 1108 mainframe computer using disk packs and 9-track tape for off-line storage. The objective of the file system was to eliminate the need for separately named files for each data set by creating a number of time series in the same disk file. The series' were stored sequentially and routines were written to store new series and delete old series to/from each file.

A later version of FESTSA, called RUSPAC [2] was developed at Nova University, which added a "Delete Disk," a temporary disk storage area which was created at the beginning of a session and deleted at the end. Off-line storage was on disk packs and tape called "Keep Disks" and "Keep Tapes" to distinguish them from the Delete Disks. The user implemented his own routines by communicating the data to and from existing routines via a named common area called "CSER."

PAK differs from these earlier packages in that it uses an established high level language and library of routines for analysis, called "MATLAB" and an established plotting and analysis package called "ORIGIN" [3,4]. PAK runs on a personal computer under Microsoft Windows rather than on a mainframe computer. In PAK, the user communicates data to and from storage devices and other routines through MATLAB variables. PAK also makes use of a Graphical User Interface to make analysis interactive and easier to use. PAK still retains the ability of the earlier systems to run in a "batch" mode by storing a sequence of key strokes in a script file. The script file is then run as a batch file. See Fig. 1 for PAK data flow diagram.

An individual time series is composed of a header record followed by many data records. The header record contains the start time, expressed in seconds from Jan 1, 1968, the data interval in seconds, the number of data points in the series, the ID Number of the Pak function that produced the series, if such was the case, the date the function produced the series, and an ASCII message, which can describe the conditions under which the data were collected (e.g., type of data, experiment name, location, date, etc.). The data can be integer, real, or complex.

A number of related time series' are stored in a data file -- either a permanent file, a temporary file called the "delete

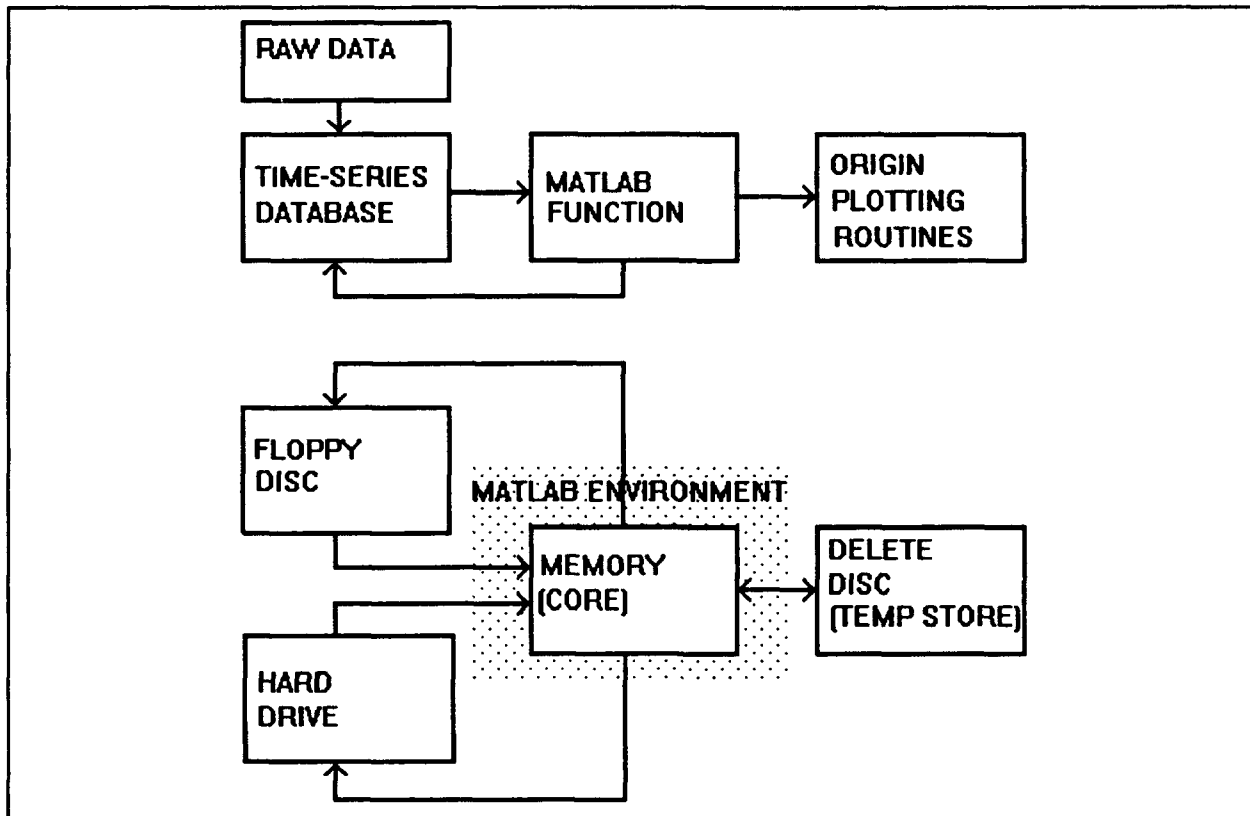


Figure 1. PAK Data Flow

disk," or reside in memory called "core." Each file has a header record composed of an ASCII header message only. This message is intended to contain a general description of the series' contained within the data file. For example, a data file containing time series' taken from a current meter deployed during the HI-RES experiment might contain the header record message, "Current meter data collected at 30.1° N, 72.5° W, from 2 Jul 93 to 15 Aug 93, during the HI-RES experiment."

SETUP

To use the PAK functions the script files must be accessible to the system. The suggested directory, for the copy of these files, is \matlab\toolbox\pak\. The path variable for MATLAB must be modified to search this directory. The user can type the command to add this directory to the search path during the MATLAB session; the command to add this directory to the search path can be included in the startup.m file; or it can be defined in matlabrc.m [3].

The system has two data files that the user can elect to modify using any text editor. The file dirlist.dat contains the list of valid data directories for PAK to locate series data files. The

file funclist.dat contains a list of functions that can be used to process data series. For each function this file will contain three records. The first record contains the *.m file name for the function. The second record contains the label for creating the menu option to select the function. The third record contains the number of series required as input for the function. These two files allow the user to customize the PAK program.

RUNNING PAK

The PAK program has two optional command line arguments. The first selects the run mode and the second defines the parameter file for reading or writing. The command to initiate the PAK program is as follows:

```
pak [(run mode), [parameter file]]
```

The default run mode is 0; if required the default parameter file is batch.dat. The run mode defines how the user will interact with the program and if a parameter file will be used for input or will be created. The run modes are as follows:

- 0 .. mouse driven menu
- 1 .. keyboard driven menu
- 2 .. batch processing; parameter file used for all inputs
- 3 .. mouse driven menu, output a parameter file of all user inputs including menu responses for later use in mode 2
- 4 .. keyboard driven menu, output a parameter file of all user inputs including menu responses for later use in mode 2

For modes 0 and 3 most of the user interaction will be via the mouse with some keyboard input required. For modes 1 and 4 the menu options will be selected using the keyboard with some other keyboard inputs required. Mode 2 is the noninteractive mode. All inputs including menu responses are read from the input parameter file. Care should be used with this mode, since files and series are selected by their position in the list. The parameter file is an ASCII file. It can be created by the user with a text editor or by a previous run of the PAK program using mode 3 or 4. The file can be modified, as well as created using a text editor. This mode is provided to allow the user to do repeat processing. If the user saves a parameter file using mode 3 or 4 and then reruns the program using the same parameter file, then the processing will be performed exactly as it was when the user operated the system using mode 3 or 4. The parameter file can be modified to change the input file name or the series selection. This allows the user to process multiple series of a file or different files as needed without running the PAK program interactively.

PAK uses 3 types of data storage for series data: input/output

files, a working file (called the delete disk), and core (internal program memory).

Input/output files must reside in one of the directories defined in the dirlist.dat file. The selection can be altered by changing the dirlist.dat file as needed. This file is an ASCII file. It contains one entry for each directory to be included in the list of valid data directories. The entries will be read and the characters '\hd' or 'hd' will be added to the file directories to form file prefixes. All file names must begin with the character 'hd' and contain five alphanumeric characters. The first menu of the system contains the list of valid file prefixes. A sample menu follows:

OPEN FILES	Keyboard input
a:\pak\hd	1
b:\pak\hd	2
c:\pak\hd	3
d:\pak\hd	4
e:\pak\hd	5
QUIT	0

See appendix B for the dirlist.dat file used to create this menu. The user selects the menu option and is prompted for the remainder of the file name, for example if the first prefix is chosen, then the prompt is as follows:

COMPLETE FILE NAME a:\pak\hd

The user must supply the five alphanumeric characters to complete the file name. Each file can be opened only once. If the file does not exist, then it will be created. When all file names have been input the user selects QUIT to continue to the next step. If the user enters an invalid response or nothing at the file input prompt, then a message will appear and control returns to the menu.

Once all file names have been input a test is made to determine if the delete file from a previous run is available. If yes, then the user is prompted.

delete.dat .. keep or delete [D]?

If delete is chosen, the default is delete, then a new empty delete disk file is created. If the user selects keep, then the

file will be opened and used as is.

The files input by the user are tested. If the file does not exist, then it will be created. A newly created file will contain a blank header record, an end of series record, and an end of file record. See Appendix A for an explanation of these records. Input files are tested for premature end of series, premature end of file, or invalid change in series number. The file may have been corrupted due to a power shutdown during a write procedure or some other unexpected exit. If a correctable error is found then the user will have the option of fixing the file. The prompt for this fix is as follows:

Fix file .. fname (def:Y or N) -

Where fname is the name of the problem file. The fix will be done by truncating the file at the end of the last valid series.

Once all files have been opened and the program initialized, the user is presented with the main menu.

PAK	Keyboard input
File Header	1
Directory	2
Copy	3
Delete	4
Series	5
Create new series number	6
Functions	7
MATLAB command	8
Output	9
QUIT	0

This menu is the system manager. Each option will be discussed in full. There are three menus that are often used by multiple functions of PAK. These are described below. The first selects the type of data storage to be used by a function.

TITLE	Keyboard input
CORE	1
FILE	2
QUIT	0

TITLE changes with the selected application. The QUIT option will stop the function. CORE means the user will be using core data; FILE means the user will be selecting a series from the delete disk or one of the other input/output files.

When FILE is selected then a file selection menu will be given. An example of a file select menu is as follows:

FILES	Keyboard input
DELETE DISK	1
c:\pak\hd12345	2
c:\pak\hd88877	3
a:\pak\hd33445	4
QUIT	0

This menu will vary, each file the user opened at the beginning of the program run will be listed. If the number of input files cannot be contained within a single menu on the screen and the menu is mouse driven, then multiple menus will be used to display file names. PREV and NEXT will be used to change menus. The menu list is circular. If PREV is selected on the first menu, then the last menu will be displayed. If NEXT is selected on the last menu, then the first menu will be displayed.

For some applications once the CORE option or a file is selected then the menu for selecting a series will be displayed. This menu will vary for the list of series in core or the selected file. The scheme described above for multiple menus will be used when required for a series list. An example of a series menu is as follows:

SERIES .. CORE	Keyboard input
PREV	not used
(1) 26410	1
(2) 26415	2
(3) 26420	3
(4) 26425	4
(5) 26430	5
(6) 20065	6
(7) 20075	7
NEXT	not used
QUIT	0

The three menus described above will be used often, and we will refer to them as select core/file menu, select file menu, and select series menu.

File Header

The File Header option of the main menu allows the user access to the header record of any of the opened data files. When this option is selected the file select menu will be displayed for the user to select the desired file. Once a file is selected, the file header menu will be displayed as follows:

File Header	Keyboard input
List	1
Create	2
Append	3
QUIT	0

If List is chosen, then the header of the selected file will be displayed for the user. See Appendix C for an example. If create is chosen, then the user will be given the following prompt:

msg>

At this prompt the user creates a new ASCII header for the selected file. The prompt will be repeated until the user presses <return> only at the prompt. The header, if too long, will be truncated to fit the size of the header record. If the Append option is chosen, then the user will again see the prompt:

msg>

This time the information entered by the user will be added to the header record starting after the last nonblank character of the existing header. Again the prompt will be repeated until <return> is the only response at the prompt. The file header menu will be displayed after each selection until QUIT is selected.

Directory

The directory option of the main menu will allow the user to do a directory listing of the series in core or of a selected file. The user will get the select core/file menu and if file is selected then the select file menu will be displayed for the user's response. Once the selection is made, a directory listing will be displayed. See Appendix D for an example. The list includes series number, number of data values, data type, start time (or value), time interval for data values, function identification number, function date (if function identification number is not zero), and series annotation.

Copy

The copy option allows the user to copy a series from one storage medium to another. The menu for copy is as follows:

Copy	Keyboard inputs
File to Core	1
Core to File	2
Core to Delete	3
Delete to Core	4
Delete to File	5
File to Delete	6
QUIT	0

For the file to core copy the user must respond to select file and select series menus. The select file menu will not contain the DELETE DISK option for this application. Also, the user will be allowed to filter the data when it is copied. The filter menu is as follows:

FILTERS	Keyboard input
time	1
index	2
NONE	0

If the time option is selected, then the user will be prompted for start time as follows:

Enter start time as date (def:Y or N) -

for No the user is prompted

Enter start time as single value (def: ?) -

for Yes the user is prompted

Start year (def: ?) -
Start month (def: ?) -
Start day (def: ?) -
Start hour (def: ?) -
Start minute (def: ?) -
Start second (def: ?) -

In each case the default is the start time (or value) of the data to be copied. Also, the user is prompted for length of time:

Length of time in seconds (def: ?) -

The default will be for the length of time required to copy all data after the user specified start time.

If the index option is selected, then the user will be prompted for the following:

Start index (def: 1) -
Sub-sampling increment (def: 1) -
End index (def: ?) -

The default for the ending index will be the number of data values in the series. Starting at the specified start index every data value will be copied for an increment of 1, every

other data value for an increment of 2, etc., to the specified end index.

The data is copied as specified by the selected filter or all data is copied if NONE is the selected filter. If needed the series header values for start time and time increment are adjusted for the filtering. Each of the filters has a function identification number associated with it. Zero for NONE; one for time; and two for index. When filtering is used, the date for the data creation (copy) is stored in the function date portion of the series header.

For the core to file copy option the user must respond to the select series menu to select the core series to be copied, and the user must respond to the select file menu for the file to contain the copied series. The select file menu will not contain the DELETE DISK option. No filtering is allowed. The series will be appended to the end of the selected file.

For the core to delete copy option the user must respond to the select series menu to select the core series to be copied. No filtering is allowed. The series will be appended to the end of the delete disk file.

For the delete to core copy option the user must respond to the select series menu to select the delete disk series to be copied. Filtering is allowed, see option for copy from file to core for filtering menu and prompts. The filtering is applied in the same way. The copied series will be appended to the end of the core list.

For the delete to file copy option the user must respond to the select series menu to select the delete disk series to be copied and the user must respond to the select file menu for the file to contain the copied series. The DELETE DISK option will not appear as an option in the select file menu. The series will be appended to the end of the selected file. No filtering is allowed.

For the file to delete copy option the user must respond to the select file and select series menus to select the series to be copied. The selected series is copied from the selected file and will be appended to the end of the delete disk file. No filtering is allowed.

Delete

The delete option of the main menu will allow the user to delete a series from core or from a selected file. The user will get the select core/file menu. If file is selected, then the select file menu will be displayed for the user's response. Finally the select series menu will be displayed for the selected file or

core series list. When the user selects a series from the menu, that series is deleted from core or the selected file as specified by the user.

Series

The series option of the main menu allows the user to view series data and header information, alter a series header annotation, and change the series number(s). The user will get the select core/file menu. After which the menu for series will be displayed as follows:

SERIES OPERATIONS	Keyboard input
Series Header	1
View Data	2
Change Series Number	3
Resequence	4
QUIT	0

For the series header option the select series menu will be displayed for the user's response. The menu for series header is as follows:

SERIES HEADER	Keyboard input
List	1
Create Information	2
Append Information	3
QUIT	0

If list is the chosen option, then the header information for the selected series will be displayed. See Appendix E for an example. The create and append options are used to modify the information area contained within the series header. The prompting for these will be the same as that described for the main menu File Header options create and append.

For the view data option the select series menu will be displayed for the user's response. The user will then be prompted as follows:

Specify start (def: 1) -
Specify increment (def:1) -
Specify end (def: ?) -

The default for the ending index will be the number of data values contained in the selected series or the number required for printing 10 data values, the smaller of these two values will be chosen. Starting at the specified start index every data value will be displayed for an increment of 1, every other data value for an increment of 2, etc., to the specified end index. The display will include the index, time value, and data value for the specified range. See Appendix F for an example. After the display the user is prompted:

More (def:Y or N)

If yes, then the user will be prompted for the index values again and the specified data will be displayed. If no, then control returns to the series operations menu.

If change series number is the chosen option, then the select series menu will be displayed for the user's response. The series number for the selected series will be changed to the current default new series number.

If resequence is the selected option then all the series contained within core or the selected file will be assigned new consecutive series numbers. The numbering will start with the current new series number and be incremented by the current new series number increment.

Create New Series Number

The create new series number option allows the user to change the new series number and new series number increment. The new series number is assigned for newly created series, the exception is copy with no filtering, then the original series number is retained. The new series number increment is used to increment the new series number after each use. These values are also used for changing a series number and resequencing series stored in core or a selected file. The prompts for the user are as follows:

Series number (def: ?) -
Series increment (def: ?) -

The current values will be the defaults. The initial values for these are a random number for the new series number and 10 for the increment.

Functions

The functions option of the main menu allows the user to create data series for core. The menu for functions is as follows:

FUNCTIONS	Keyboard input
Create core data	1
User function	2
Filters	3
FUNCTION1	4
.	.
.	.
.	.
FUNCTIONn	n+3
QUIT	0

FUNCTION1, ... FUNCTIONn are defined in the funclist.dat file. The funclist.dat file contains the '.m' file name, menu option definition (FUNCTION1, ..., FUNCTIONn), and the number of data series required for the function. See Appendix G for an example funclist.dat file.

The create core data option allows the user to create core series using MATLAB commands. This is the most common method of converting data having arbitrary format to a PAK-formatted time series. When this option is chosen, the message and prompt to the user is as follows:

Use MATLAB commands to create data (return allows save data or type 'QUIT' for return to menu)

cmd>

The cmd> prompt repeats for the user to enter and execute MATLAB commands. These commands might include reading data from a file. To exit this mode press <return> at the prompt; typing QUIT returns the user to the functions menu and no new series is created. When <return> is pressed, the screen prompts the user to define the variable containing the series data:

Provide variable name containing data -

If the user does not enter a variable name or there is a problem

with the variable, then control returns to the cmd> prompt. This allows the user to check/alter the data. As before, the user presses <return> to continue or types QUIT to exit this mode and returns to the functions menu. Once the variable name containing the series data values has been provided, the user must provide the required header information. The following menu is used to define the data type. Data type is used only if the data series is later written to an output file:

Data Type	Keyboard input
int16	1
int32	2
flt32	3
flt64	4
comp32	5
comp64	6

The user must supply start time, time interval, and if desired series annotation information. The prompts for this information are as follows:

Enter start time as date (def:Y or N) -

for No the user is prompted

Enter start time as single value (def: 0) -

for Yes the user is prompted

Start year (def: ?) -
 Start month (def: ?) -
 Start day (def: ?) -
 Start hour (def: ?) -
 Start minute (def: ?) -
 Start second (def: ?) -

The default for the date and time is the current date/time.

Data interval (seconds) -
 Series Annotation (opt.).
 msg>

The msg> prompt will be repeated until only <return> is pressed. This information will be truncated if the message is longer than 200 bytes.

The user function option allows the user to create new core series data using existing core series data and MATLAB commands. When this option is chosen, the select series menu will be displayed for the user. The user selects one or more core series, the QUIT option closes this menu. The series data and associated time labels are stored in variables that will be listed for the user. An example of this listing is as follows:

```
d1 (core data for series: 26406)
t1 (core times for series: 26406)
d2 (core data for series: 26400)
t2 (core times for series: 26400)
```

The variable d1, t1, d2, and t2 are now available for use with MATLAB. As with create core data the prompt to the user is as follows:

Use MATLAB commands to create data (return allows save data or type 'QUIT' for return to menu)

cmd>

The cmd> prompt repeats for the user to enter and execute MATLAB commands. These commands can use the variables containing the selected series data and times. To exit this mode press <return> at the prompt; typing QUIT returns the user to the functions menu and no new series is created. The QUIT option is useful for when the user simply wishes to manipulate or plot the data without creating a new series. When <return> is entered, the screen prompts the user to define the variable containing the series data:

Provide variable name containing data -

If the user does not enter a variable name or there is a problem with the variable, then control returns to the cmd> prompt. This allows the user to check/alter the data. As before the user presses <return> to continue or types QUIT to exit this mode and return to the functions menu. Once the variable name containing the series data values has been provided, the user must define the header information. The user has the option of defaulting to the data type, start time, and time interval of the first series selected or these values can be specified by the user. The prompt for the user is as follows:

Keep header attributes of series: ? (def:Yes) -

For this example ? will be 26406, the first series selected. If yes is selected, then the user will be prompted for the optional series annotation information:

Series annotation(opt.).

msg>

For more information about this prompt see the description for create core data. If no is selected for keep header attributes, then the user will be prompted for the required information. For a description of the prompts for the required header information see the discussion for create core data. The assigned function number will be 999, for user functions.

The Filters option allows the user to create a new series for core by filtering an existing core series. For this option the select series menu will be displayed for the user's response. Once a series is selected the filters menu will be presented. See the file to core option of the copy menu for a description of the filters menu, prompts, and the discussion of the available filters.

The option of FUNCTIONm (m = an integer from 1 to n where n is the number of functions defined in the funclist.data file). A user can add functions to the system by creating the definition in the funclist.dat file. For each function three records are required. The file is ASCII and can be easily modified using any text editor. The first record contains the name of the '.m,' MATLAB script, file containing the function. The second record contains the label to be shown in the menu, in place of FUNCTION1, ... FUNCTIONn. The third record contains the number of data series required by the function. See Appendix G for an example of a funclist.dat file constructed in this way. The select series menu will be displayed for the user to select the series' required for the function. Once the series' are selected, the function is executed, the new data series is stored in core and the function identification number is entered as (m+49). For the sample menu shown, FUNCTION1 would have a function identification number of 50; and the user is prompted for series annotation (see discussion for create core data for a description of this prompt). If the user selects only the QUIT option from the select series menu, no data will be processed or stored.

The calling syntax for the function must be as follows:

```
[stime, inter, data, dtype] = fname( cstime1, cinter1,
cdatal, ... cstimeN, cinterN, cdataN )
```

The returned values must be defined by the function:

- 'stime' is the start time (or value) for the newly created data.
- 'inter' is the interval in seconds (or appropriate increment) for the new data.
- 'data' is the array containing the newly created data series.

'dtype' is the data type for the newly created data series (see Appendix A for value descriptions). This value is used only if the data series is later written to a file.

Three input values will be sent to the function for each series selected for processing by this function:

'cstimeN,' where N is an integer from 1 to the number of series required for the function as defined in the funclist.dat file. cstime is the start time for the relevant data series.

'cinterN,' where N is the same as for cstimeN. cinter is the time interval for the relevant data series.

'cdataN,' where N is the same as for cstimeN, is the array of data values that constitute the series.

MATLAB Command

The MATLAB command option in the main menu will allow the user to enter and execute MATLAB commands. The message and prompt for entering MATLAB commands is as follows:

```
Enter MATLAB commands (return to quit)
cmd>
```

When you are finished and wish to return to the main menu, simply press <return>.

Output

The Output option of the main menu allows the user to output series information and data to a data file. The menu for this mode will be displayed for the user's response:

OUTPUT	Keyboard input
Directory	1
File Header	2
Series Header	3
Data Dump	4
ASCII data	5
ORIGIN command file	6
QUIT	0

Once the user has selected an option, the output file name prompt will be displayed for the user's response:

Provide output file name (def: ?) -

The default file name is temp.dat, unless the ORIGIN command file option is selected. The default file name for the ORIGIN command file option is \origin\origin.txt. These default file names can be found in the include.m file. The output files are ASCII data files.

For the Directory option of the output menu, the select core/file menu will be displayed. If file is selected, then the select file menu will be displayed. Once core or the specific file is selected then a directory listing will be output to the specified file. The directory list includes series number, number of data values, data type, start time (or value), time interval for data values, function identification number, function date (if function identification number is not zero), and series annotation. See Appendix D for an example. For a hard copy of the directory, print the file using the winodw file manager.

For the File Header option of the output menu, the select file menu will be displayed for the user's response. When a file has been selected, the ASCII file header will be output to the specified file. See Appendix C for an example.

For the Series Header option of the menu the select core/file menu will be displayed for the user's response. If file is selected, then the select file menu will be displayed for the user's response. Finally, the select series menu will be displayed for the user's response. Once a series has been selected, the series header information is output to the specified file. See Appendix E for an example.

For the Data Dump option of the menu the select core/file menu will be displayed for the user's response. If file is selected, then the select file menu will be displayed for the user's response. Finally, the select series menu will be displayed for the user's response. Once a series has been selected, the user will be prompted as follows:

Specify start (def: 1) -
Specify increment (def:1) -
Specify end (def: ?) -

The default for the ending index will be the number of data values contained in the selected series or the number required for the output of 10 data values, the smaller of these two values will be chosen. Starting at the specified start index every data value will be output for an increment of 1, every other data value for an increment of 2, etc., to the specified end index.

The output will include the index, time value, and data value for the specified range. After the display the user is prompted:

More (def:Y or N)

If yes, then the user will be prompted for the index values again and the specified data will be appended to the specified data file. If no, control returns to the series operations menu.

For the ASCII data option of the menu the select core/file menu will be displayed for the user's response. If file is selected then the select file menu will be displayed for the user's response. Finally, the select series menu will be displayed for the user's response. Once a series has been selected, one record will be output for each data value in the series. Each record will contain two values, the first is the time value and the second is the series data value. See Appendix H for an example.

For the ORIGIN command file option of the menu the select core/file menu will be displayed for the user's response. If file is selected, then the select file menu will be displayed for the user's response. Finally, the select series menu will be displayed for the user's response. Once a series has been selected, the user will be prompted for extra information as follows:

Enter worksheet name (def: matlab) -
Enter first column name (def: T) -
Enter second column name (def: D) -
Output start time ? (def:Y or N for resent to 0) -

For information on ORIGIN worksheet and column names see reference 2. For start time the ? is replaced with the series start time (a single value). The user can elect to adjust time values to start at 0. The output for this option is an ASCII file. The file is an ORIGIN script file. (The file can be run within the ORIGIN script window to load series data into an ORIGIN work sheet.) See Appendix I for an example. If this script file is executed under origin, then the data will automatically load into an ORIGIN worksheet, ready for plotting.

QUIT

The QUIT option exits the PAK function. The user will be prompted as follows:

Exit program (def: Y or N) -

The user is given a chance to not exit the program. If the user does exit the program, then the user is prompted as follows:

delete.dat .. keep or delete [D]?

The user can elect to keep the delete disk file that was created. If the user chooses to keep the file, then the next and final prompt will be as follows:

Desired file name (def: delete.dat) -

The user can rename the file to create a new output series file.

DISCUSSION

PAK is a processing system designed for vectorized time-series data. The user can create and/or manipulate vectorized data. The system is written in MATLAB. A data set is known as a series. A series is defined by series number for identification, start time (or start value), increment for start time, and a list of data values. Other values are stored with the series for documentation purposes. Input files can contain multiple series, see Appendix A for data file format. Series are stored in data files or in memory (called core). See Fig. 1 for PAK data flow diagram. Each file has an ASCII file header for documentation, followed by one or more data series.

The PAK function is designed to process vector data. The user can customize the system by modifying the file that contains the list of valid directories and/or the file that contains the list of data processing functions. The system is menu operated with some keyboard input required; or an input parameter file can be used for repeat processing operations. When the program is initiated, the user selects the run mode. When selecting core/file, file name, or series, the user can select the QUIT option of the menu to exit the selected operation. The system provides output for use with ORIGIN or an ASCII list file of the data for transporting the data to other processing systems.

The PAK routines described here only cover the data management "housekeeping" functions necessary to move data in and out of PAK storage, delete series, and create and modify header records. The intent was to create a skeleton system that the user could build upon using the open architecture of the MATLAB language and the script, funclist.dat, described earlier. The user, then, can combine several MATLAB functions into a '.m' file, store the file in a toolbox, and modify funclist.dat appropriately in order to include his/her favorite functions in the PAK. This process will be ongoing in the Remote Sensing Applications Branch (Code 7240) at the Naval Research Laboratory (NRL). User comments and/or contributed functions will always be welcome.

The PAK software can be obtained from the authors or by Anonymous FTP over the INTERNET. The following UNIX commands will retrieve a copy of this report together with required '.dat' files and MATLAB source code in the form of '.m' subroutines:

Ftp_snaps.nrlssc.navy.mil

anonymous

cd pub/pak

binary

get pak.exe

pak.exe is to be executed under the MS-DOS operating system and is self-extracting. The resulting files will be a series of .m files and two .dat files, which should be placed in a MATLAB toolbox named 'pak' and pak.wp, which is a copy of this report in wordperfect format. For a list of all required files see Appendix J.

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3. "MATLAB User's Guide," The MathWorks, Inc., 24 Prime Park Way, Natick, MA 01760, phone: (508) 652-1415, FAX: (508) 653-2997, August 1992.
4. "LabTalk," MicroCal Software, Inc., 1991-1993.

Appendix A

Series File Format

all records 516 bytes

record 1 (of file)
1-516 I4(128) info (user supplied)

record 1 (of series)
1-4 I4 series number
5-8 I4 number of data points
9-12 I4 number of data records
13-16 I4 data type
1 int16,
2 int32,
3 flt32,
4 flt64,
5 complex flt32,flt32
6 complex flt64,flt64
17-24 F8 seconds since Jan 1, 1968
25-32 F8 interval in seconds
33-36 I4 function ID
37-40 I4 function year
41-44 I4 function month
45-48 I4 function day
49-248 I4(50) series annotation (user supplied)
249-516 misc.

record 2-n (of series)
1-4 I4 series number
5-516 ? data of type specified
in header record
(pad with value 999999 to complete
partial last record as needed)

record n+1 (end of series)
series number of 999999 and pad with 999999

last record of file (end of file)
series number of 999999 and pad with 999999

Appendix B

Sample dirlist.dat file

a:\pak\
b:\pak\
c:\pak\
d:\pak
e:\pak

Appendix C

Sample File Header Listing

delete disk file header created using th
e file header, create option of the pak
function the data in this file create Ma
rch 9, 1994

Appendix D

Sample Directory listing

Series	Number Points	Data Type	Start Time (Start Value)	Interval	Function Id	Function Date	Annotation
116495	20	flt32	100.0010	0.0010	002	Feb 24, 1994	
116505	20	flt32	1000.0010	0.0010	000		test series a=1:20;

Appendix E

Sample Series Header Listing

Series number - 116505
Number of points - 20
Data type - flt32
Time of data - 1000
Data interval - 0.001
function - 000
info> test series a=1:20;
info>
info>
info>
info>

Appendix F

Sample Data View (Dump)

1	...	826991069.5400	...	1.0000000000
2	...	826991070.0400	...	2.0000000000
3	...	826991070.5400	...	3.0000000000
4	...	826991071.0400	...	4.0000000000
5	...	826991071.5400	...	5.0000000000
6	...	826991072.0400	...	6.0000000000
7	...	826991072.5400	...	7.0000000000
8	...	826991073.0400	...	8.0000000000
9	...	826991073.5400	...	9.0000000000
10	...	826991074.0400	...	10.0000000000

Appendix G

Sample funclist.dat File Containing Two Entries

pspec
Elev Pow Spec
1
wvel
Elev Time Ser
1

Appendix H

Sample ASCII File Listing

1000.0010000000	1.0000000000
1000.0020000000	2.0000000000
1000.0030000000	3.0000000000
1000.0040000000	4.0000000000
1000.0050000000	5.0000000000
1000.0060000000	6.0000000000
1000.0070000000	7.0000000000
1000.0080000000	8.0000000000
1000.0090000000	9.0000000000
1000.0100000000	10.0000000000
1000.0110000000	11.0000000000
1000.0120000000	12.0000000000
1000.0130000000	13.0000000000
1000.0140000000	14.0000000000
1000.0150000000	15.0000000000
1000.0160000000	16.0000000000
1000.0170000000	17.0000000000
1000.0180000000	18.0000000000
1000.0190000000	19.0000000000
1000.0200000000	20.0000000000

Appendix I

Sample ORIGIN Script File Listing

```
create matlab -w 20 T D
matlab_T[1] = 111.100000
for(i=2;i<21;i+1){matlab_T[i] = matlab_T[i-1] + 0.100000}
matlab_D[1]=1.000000;matlab_D[2]=1.414214;matlab_D[3]=1.732051;ma
tlab_D[4]=2.000000;matlab_D[5]=2.236068;matlab_D[6]=2.449490;matl
ab_D[7]=2.645751;matlab_D[8]=2.828427;matlab_D[9]=3.000000;matlab
_D[10]=3.162278;
matlab_D[11]=3.316625;matlab_D[12]=3.464102;matlab_D[13]=3.605551
;matlab_D[14]=3.741657;matlab_D[15]=3.872983;matlab_D[16]=4.00000
0;matlab_D[17]=4.123106;matlab_D[18]=4.242641;matlab_D[19]=4.3588
99;matlab_D[20]=4.472136;
```

Appendix J

List of Files Required for Running PAK and WorkPerfect Documentation File Describing the System

asciic.m	serdelc.m
asciif.m	serdelf.m
c2file.m	serops.m
cdir.m	serseq.m
crdata.m	strlen.m
day2sec.m	userfunc.m
ddisp.m	vdatac.m
dfilter.m	vdataf.m
dirlist.dat	wheader.m
dispr.m	wrdata.m
dlistrd.m	
dofunc.m	
fcheck.m	
fdelete.m	
fheader.m	
file2c.m	
file2f.m	
filtc.m	
fixmat.m	
flistrd.m	
funclist.dat	
fverify.m	
getdate.m	
headerc.m	
headerf.m	
iinput.m	
include.m	
initpak.m	
mcomm.m	
mmenu.m	
msginput.m	
newcore.m	
newton.m	
originc.m	
originf.m	
pak.m	
pak.wp	
pakfunc.m	
pakout.m	
pspec.m	
rddata.m	
rheader.m	
sdir.m	
sec2day.m	
selserc.m	
selsurf.m	
sercpy.m	